

Contents

| | Acknowledgments | page xi |
|------------|---|---|
| Chapter 1: | Introduction, definition, and general characteristics 1.1 Introduction 1.2 Overview of LIP style through time 1.3 LIPs on other planets 1.4 Global LIP barcode record of Earth 1.5 Origin of LIPs 1.6 Global distribution of LIPs 1.7 Summary | 1 1 5 9 9 11 11 39 |
| Chapter 2: | Essential criteria: distinguishing LIP from non-LIP events 2.1 Introduction 2.2 Essential attributes of LIPs 2.3 Associated magmatism (silicic, carbonatitic and kimberlitic) 2.4 Types of non-LIP magmatism 2.5 LIP fragments/remnants 2.6 Summary | 40 40 40 50 50 53 55 |
| Chapter 3: | Continental flood basalts and volcanic rifted margins 3.1 Introduction 3.2 Continental flood basalts (CFBs) 3.3 Volcanic rifted margins 3.4 Thematic issues related to CFBs 3.5 Remnants of CFBs in the older LIP record 3.6 Summary | 56 56 56 76 77 83 89 |
| Chapter 4: | Oceanic LIPs: oceanic plateaus and ocean-basin flood basalts and their remnants through time 4.1 Introduction 4.2 Oceanic plateaus 4.3 Ocean-basin flood basalts | 90 90 91 98 vii |

| 111 | Cantant |
|-----|----------|
| *** | Contents |

| | 4.4 4.5 4.6 4.7 | Accreted oceanic plateaus Pre-Mesozoic oceanic LIPs | 98 100 103 108 |
|------------|--|---|--|
| Chapter 5: | Plu 5.1 5.2 5.3 5.4 5.5 5.6 | mbing system of LIPs Introduction Dolerite dyke swarms Dolerite sill provinces Differentiated intrusions Magmatic underplating Relations between different components of LIP plumbing | 111 111 112 123 134 143 |
| | 5.7 | system Summary | 145 152 |
| Chapter 6: | Arc 6.1 6.2 6.3 | hean LIPs Introduction Archean flood basalts Archean greenstone belts of the tholeiite–komatiite | 154 154 154 |
| | 6.4 | association Summary | 162 178 |
| Chapter 7: | Plar 7.1 7.2 7.3 7.4 7.5 7.6 7.7 | Introduction Mars Venus Mercury The Moon Io: satellite of Jupiter Summary | 179 179 179 192 205 207 211 211 |
| Chapter 8: | Silic 8.1 8.2 8.3 8.4 8.5 8.6 8.7 | Introduction Silicic magmatism associated with LIPs Silicic LIPs (SLIPs) Precambrian SLIPs Speculative SLIPs Discussion Summary | 214 214 216 219 227 238 239 243 |
| Chapter 9: | | s with carbonatites, kimberlites, and prophyres/lamproites Introduction Carbonatites and LIPs | 245 245 245 |

| 0 | 9790 |
|----------|------|
| Contents | 1X |
| | 171 |

| | 9.3 | Kimberlites and LIPs | 262 | |
|-------------|----------------------|--|------|--|
| | 9.4 | Lamprophyres, lamproites, and LIPs | 272 | |
| | 9.5 | Summary | 276 | |
| Chapter 10: | Geochemistry of LIPs | | | |
| | 10.1 | Introduction | 277 | |
| | 10.2 | Mantle sources and processes for producing LIPs | 277 | |
| | 10.3 | Overview of geochemical variations among LIPs | 292 | |
| | 10.4 | Geochemistry of oceanic LIPs | 292 | |
| | 10.5 | Geochemistry of continental flood basalts (CFBs) | 299 | |
| | 10.6 | Geochemistry of the LIP plumbing system | 305 | |
| | 10.7 | Geochemistry of Archean LIPs | 317 | |
| | 10.8 | Geochemistry of anorogenic boninite series rocks | 321 | |
| | 10.9 | Geochemistry of carbonatites, kimberlites, | | |
| | | and lamprophyres/lamproites | 328 | |
| | 10.10 | Geochemistry of associated silicic magmatism | 332 | |
| | 10.11 | Geochemistry of the LIP as a system | 335 | |
| | 10.12 | Summary | 337 | |
| Chapter 11: | LIPs, | rifting, and the supercontinent cycle | 339 | |
| | 11.1 | Introduction | 339 | |
| | 11.2 | LIPs, continental breakup, and formation of ocean basins | 339 | |
| | 11.3 | Active/passive rifting and rift classification | 341 | |
| | 11.4 | Triple-junction rifting | 345 | |
| | 11.5 | Timing of LIPs and rifting | 351 | |
| | 11.6 | LIPs that did not result in continental breakup | 352 | |
| | 11.7 | LIPs and continental breakup | 354 | |
| | 11.8 | LIPs and supercontinents | 356 | |
| | 11.9 | Using LIPs to reconstruct supercontinents | 363 | |
| | 11.10 | Summary | 369 | |
| Chapter 12: | | and topographic changes | 370 | |
| | 12.1 | Introduction | 370 | |
| | 12.2 | Domal uplift associated with LIPs | 370 | |
| | 12.3 | Mechanisms that control uplift and variation | | |
| | | through time | 384. | |
| | 12.4 | Regional domal uplift prior to LIP magmatism | 393 | |
| | 12.5 | Uplift changes during LIP magmatism | 393 | |
| | 12.6 | Post-LIP topographic changes | 395 | |
| | 12.7 | Summary | 398 | |
| Chapter 13: | | and links with contractional structures | 399 | |
| | 13.1 | Introduction | 399 | |
| | 13.2 | Contractional structures associated with domal uplift | 399 | |

x Contents

| | 13.3 | LIPs in a back-arc setting | 407 | | |
|-------------|---|--|------------|--|--|
| | 13.4 | Convergent zones (orogenic/deformation belts) | | | |
| | | linked to distal LIPs through the plate-tectonic circuit | 409 | | |
| | 13.5 | Summary | 417 | | |
| Chapter 14: | LIPs and environmental changes and catastrophes | | | | |
| | 14.1 | Introduction | 418 | | |
| | 14.2 | | 418 | | |
| | 14.3 | LIPs and their environmental consequences | 419 | | |
| | 14.4 | Effects of LIPs on climate | 432 | | |
| | 14.5 | Problem of different time scales | 443 | | |
| | 14.6 | Environmental effects of LIPs | 443 | | |
| | 14.7 | HEATT (haline euxinic acidic thermal transgression) model | 451 | | |
| | 14.8 | Summary | 457 | | |
| Chapter 15: | | ssing the origin of LIPs | 459 | | |
| | 15.1 | | 459 | | |
| | 15.2 | S | 459 | | |
| | 15.3 | Section of the sectio | 476 | | |
| | 15.4 | | 485 | | |
| | 15.5 | Assessing LIP origin from associated carbonatites and | | | |
| | | kimberlites | 493 | | |
| | 15.6 | Origin of multiple pulses | 494 | | |
| | 15.7 | | 495 | | |
| | 15.8 | Review of critical parameters related to LIP origin | 496 | | |
| | 15.9 | Summary | 497 | | |
| Chapter 16: | LIPs and implications for mineral, hydrocarbon, and water | | | | |
| | resou | | 499 | | |
| | 16.1 | | 499 | | |
| | 16.2 | | 503 | | |
| | 16.3 | | 523 | | |
| | 16.4 | 1 | = 0.6 | | |
| | | by weathering) | 536 | | |
| | 16.5 | LIPs and supercontinent reconstruction (indirect | | | |
| | 166 | links between LIPs and metallogeny) | 538 | | |
| | 16.6 | | 539 | | |
| | 16.7 | compression/transpression Implications for the oil industry | 539 | | |
| | 16.8 | LIPs and water resources | 543 | | |
| | 16.9 | Summary | 543 | | |
| | | • | | | |
| | Refer Index | rences | 545 641 | | |
| | inaex | | 041 | | |